

BIOCHEMISTRY

Inorganic =

- Molecules that do NOT contain carbon chains
- Examples:
 - Oxygen
 - Carbon Dioxide
 - Water

Organic =

- Molecules that contain carbon chains
- Examples:
 - Carbohydrates
 - Lipids
 - Proteins
 - Nucleic Acids
 - ATP

Inorganic Compounds

- **Oxygen (O_2)**
 - Essential for most living organisms
 - Involved with the extraction of energy from food molecules
- **Carbon Dioxide (CO_2)**
 - By-product of the breakdown of food molecules
 - Exhaled during respiration
 - Becomes toxic if allowed to accumulate within cells

- **Water (H_2O)**

- Important for living organisms because:

1. Stabilizes body temperature
2. Provides protection by acting as a lubricant or cushion
3. Necessary for many chemical reactions
4. Transports many substances

Organic Compounds: Overview

Carbohydrates

- Elements
 - C, H, O
- Building Blocks
 - Monosaccharides
- Function
 - Energy

Lipids

- Elements
 - C, H, O
 - P, N in some
- Building Blocks
 - Glycerol and fatty acids
- Functions
 - Energy
 - Structure
 - Regulation

Proteins

- Elements
 - C, H, O, N
 - S in most
- Building Blocks
 - Amino Acids
- Functions
 - Regulation
 - Structure
 - Energy
 - Contraction
 - Transport
 - Protection

Nucleic Acids

- Elements
 - C, H, O, N, P
- Building Blocks
 - Nucleotides
- Functions
 - Regulation
 - Heredity
 - Protein Synthesis

Carbohydrates

- Sugars are easy for cells to both make and break down
- Convenient way for cells to store chemical **energy**
- Their breakdown provides cells with **energy** for various activities

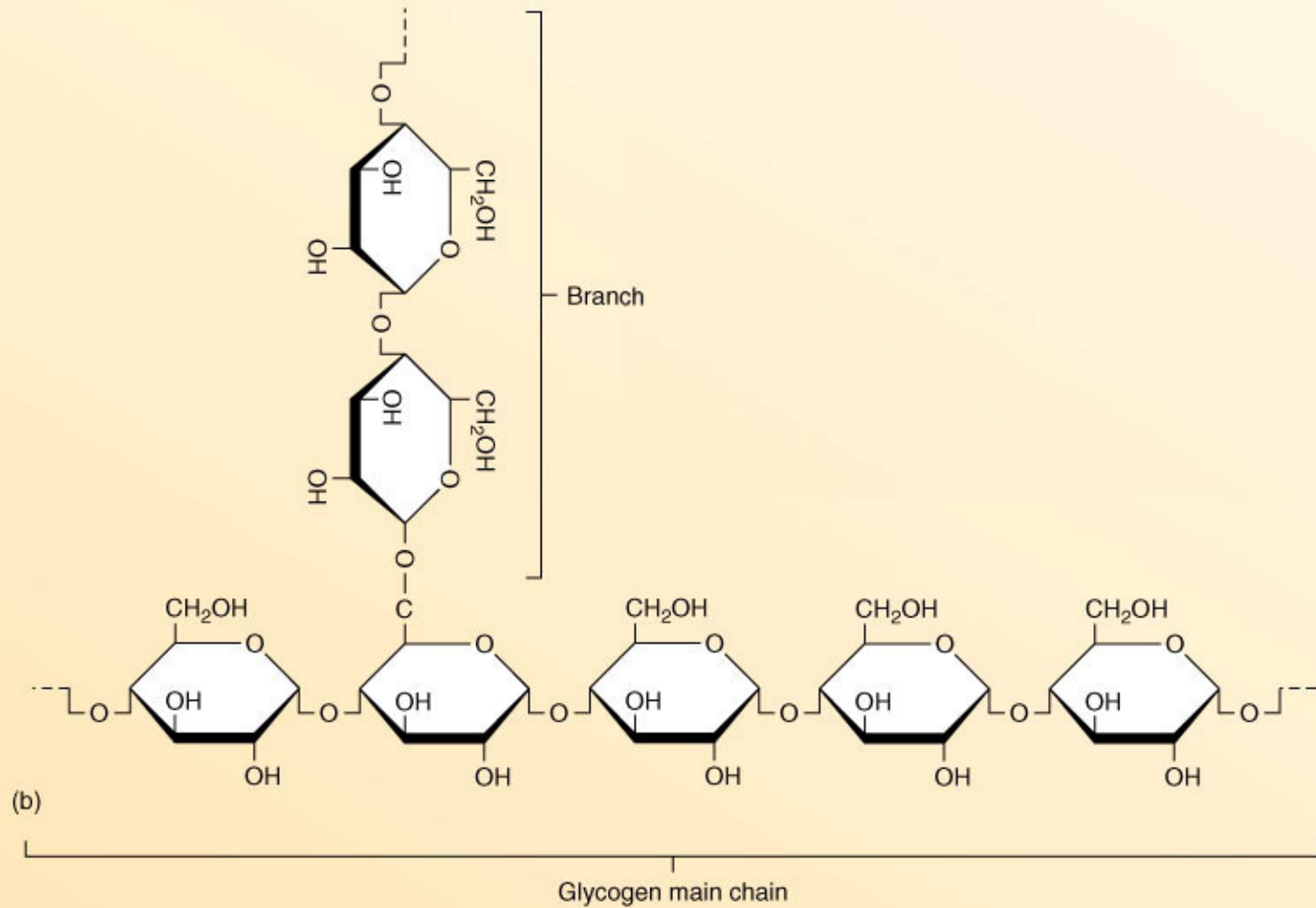
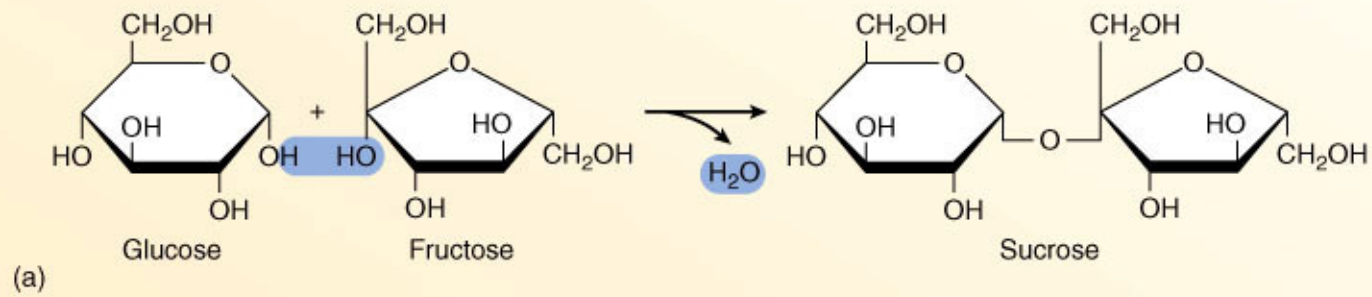
- **Monosaccharides** =

- Simple sugars ($C_6H_{12}O_6$)
- Examples
 - Glucose (blood sugar)
 - Fructose (fruit sugar)
 - Galactose (milk sugar)

- **Disaccharides** =

- Formed when two monosaccharides join
 - Example
 - Glucose + fructose = sucrose (table sugar)

- **Polysaccharides** =
 - Many monosaccharides bound in long chains
 - Examples
 - Cellulose
 - Structural component of plant cell walls
 - Plant starch
 - Glycogen (animal starch)



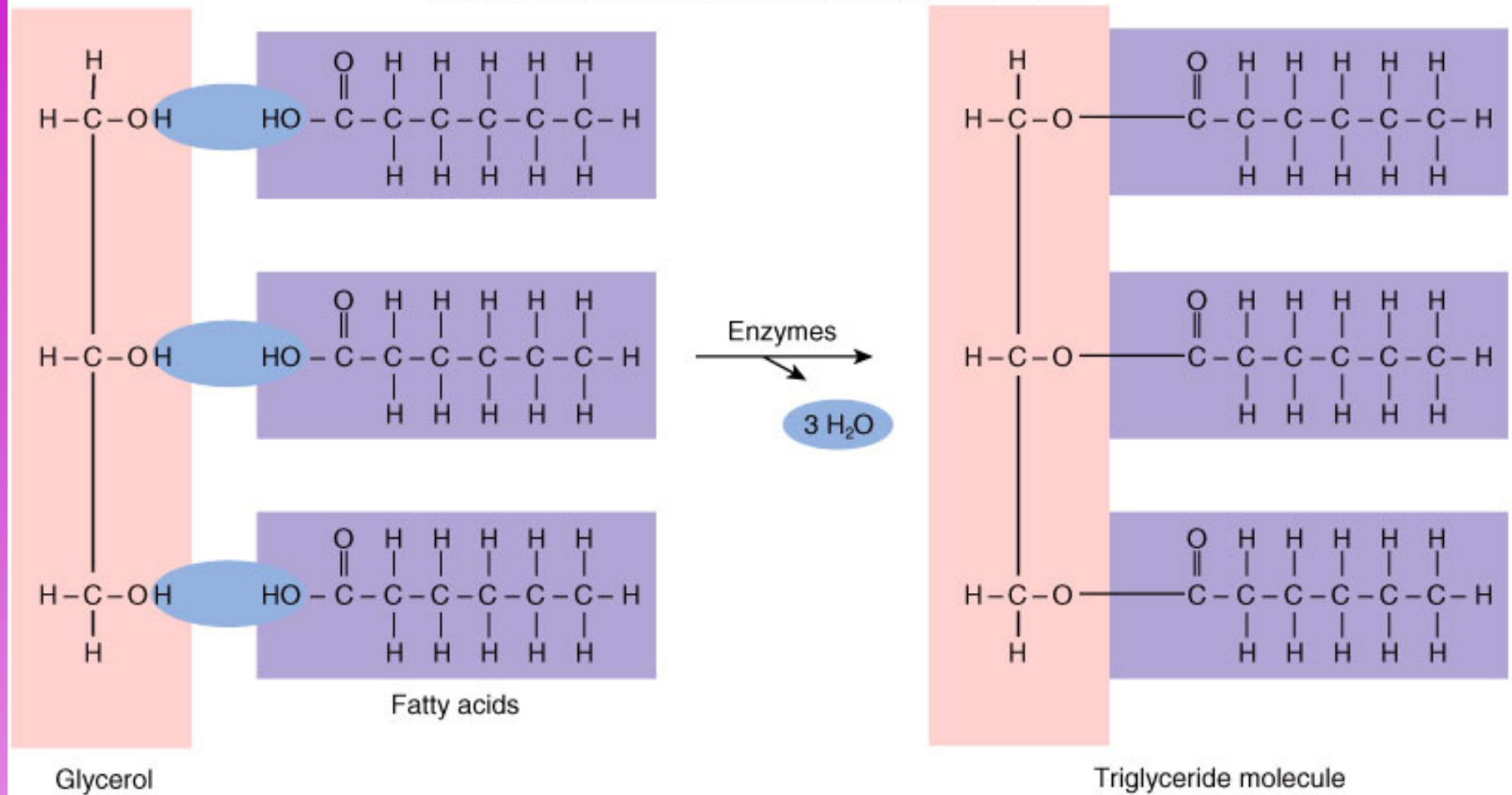
Lipids

- Dissolve in nonpolar solvents (such as alcohol or acetone) but not in polar solvents (such as water)
- Waxy, fatty, or oily compounds
- Examples
 - Fats
 - Phospholipids
 - Steroids

Fats

- Important **energy-storage** molecules
- **Pad and insulate** the body
- Building blocks of fats are
 - **Glycerol**
 - 3 carbon molecule with a **hydroxyl group** (-OH) attached to each C
 - **Fatty acids**
 - Carbon chain with a **carboxyl group** (-COOH) attached at one end

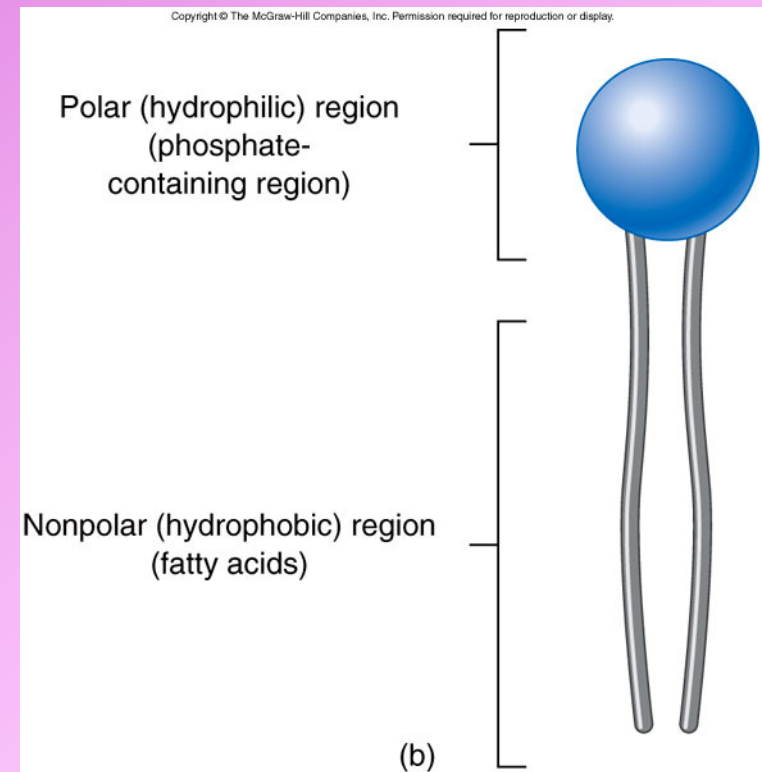
- **Triglycerides** =
 - Most common type of fat molecules
 - 3 fatty acids bound to a glycerol
- **Saturated fats** =
 - Contains only single covalent bonds between carbon atoms
 - Contribute to development of cardiovascular disease



- **Unsaturated fats** =
 - Contain one or more double covalent bonds
 - Best types of fats in the diet
 - **Monounsaturated fats** =
 - Have one double covalent bond between carbon atoms
 - **Polyunsaturated fats** =
 - Have 2 or more double covalent bonds between carbon atoms

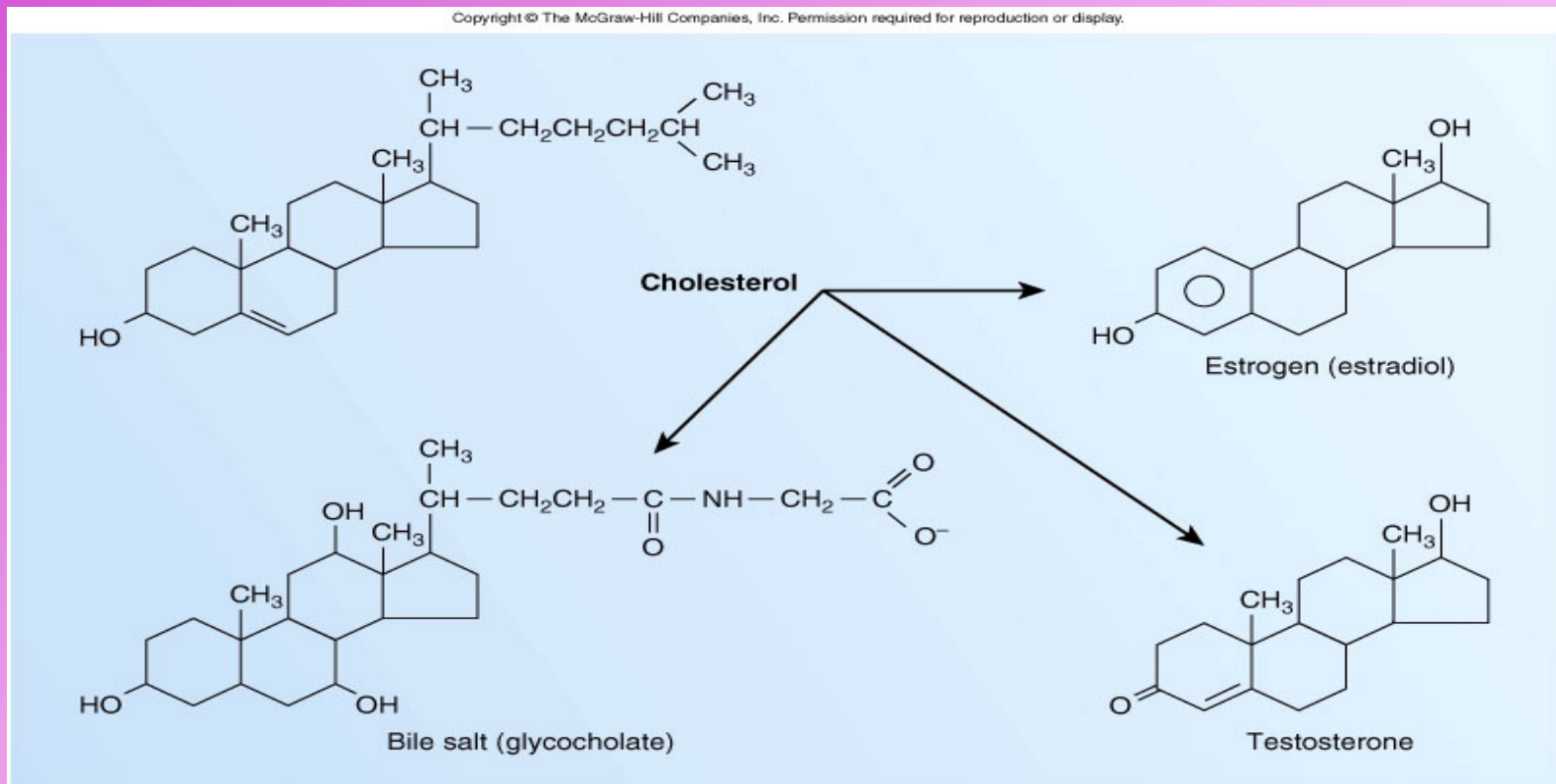
Phospholipids

- Important components of **cell membranes**
- 2 fatty acids, glycerol, phosphate molecule
 - Phosphate end is polar and is attracted to water
 - **Hydrophilic** =
 - Water loving
 - Other end is nonpolar and is repelled by water
 - **Hydrophobic** =
 - Water fearing



Steroids

- **Regulate** many physiological processes
- Composed of carbon atoms bound together into 4 ringlike structures



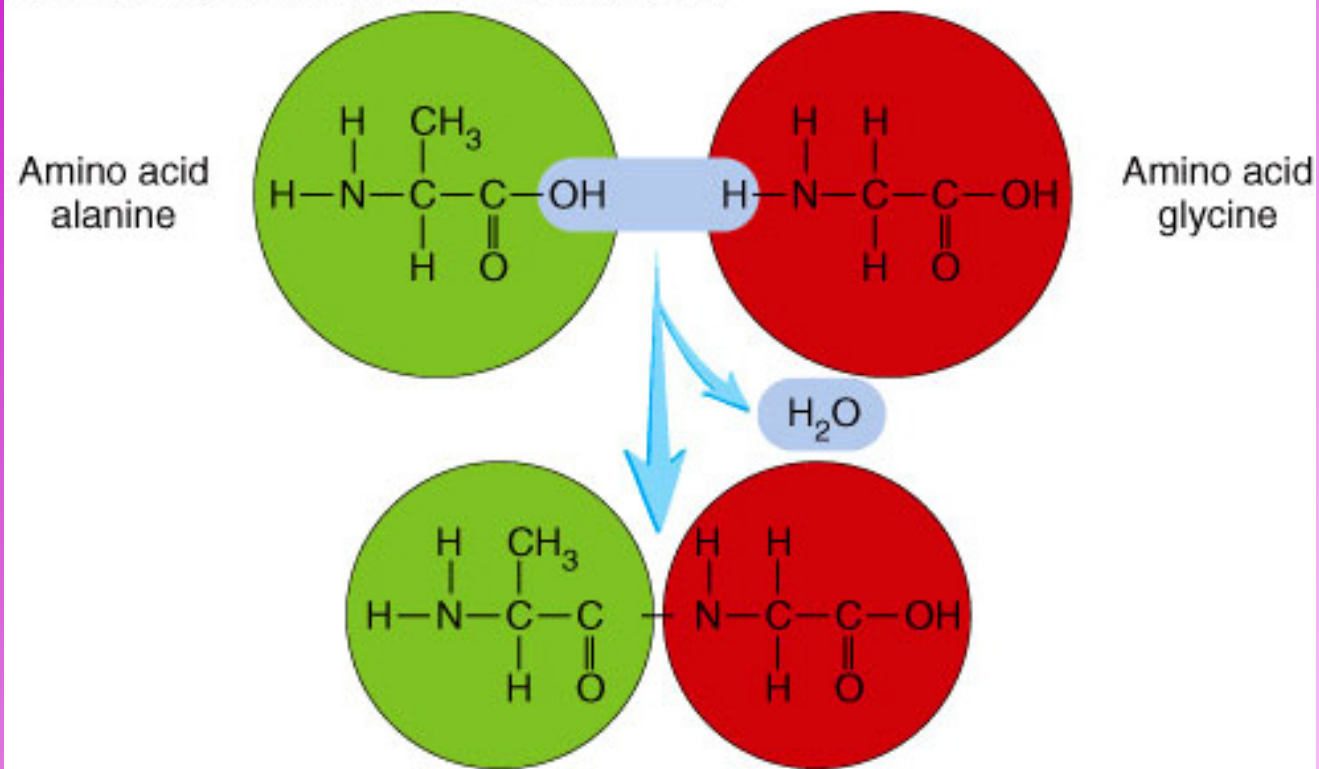
- Examples:
 - Cholesterol
 - Other molecules are synthesized from cholesterol
 - Important component of cell membranes
 - High levels in the blood increase risk of cardiovascular disease
 - Bile salts
 - Increase fat absorption in intestines
 - Reproductive hormones
 - Estrogen
 - Progesterone
 - Testosterone

Proteins

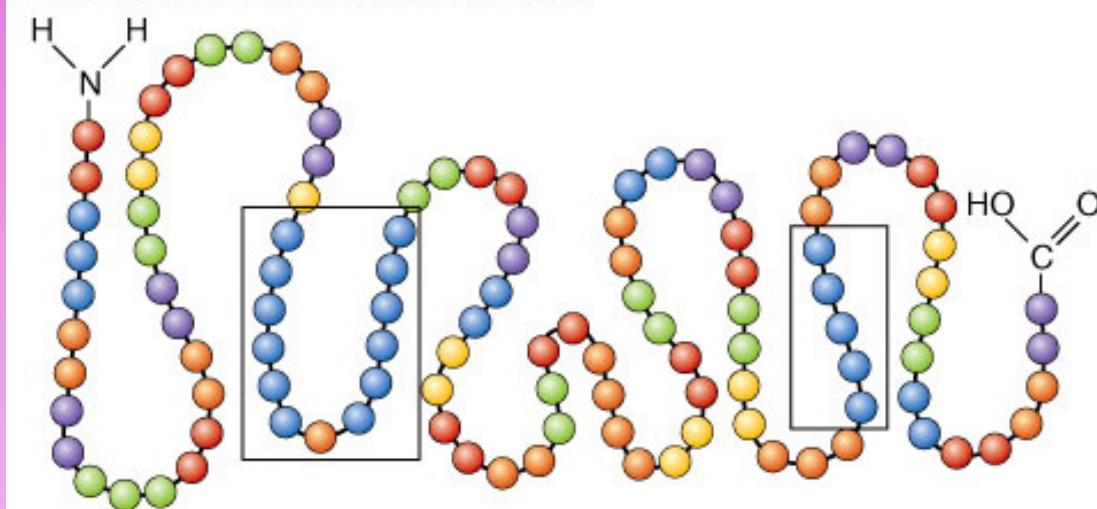
- Important Functions
 - Enzymes- Control the rate of chemical reactions
 - Hormones- regulate physiological processes
 - Collagen fibers- Form structural frameworks
 - Proteins- Can be broken down for energy
 - Actin and myosin- Responsible for muscle contraction
 - Hemoglobin- Transport oxygen in the blood
 - Antibodies- Protect against microorganisms

- Made up of **amino acids**
 - Central carbon bonded to an amine group ($-\text{NH}_2$), a carboxyl group ($-\text{COOH}$), a hydrogen atom, and the “R” group
 - There are 20 basic types of amino acids
- **Polypeptide** =
 - Chain of amino acids

Graw-Hill Companies, Inc. Permission required for reproduction or display.

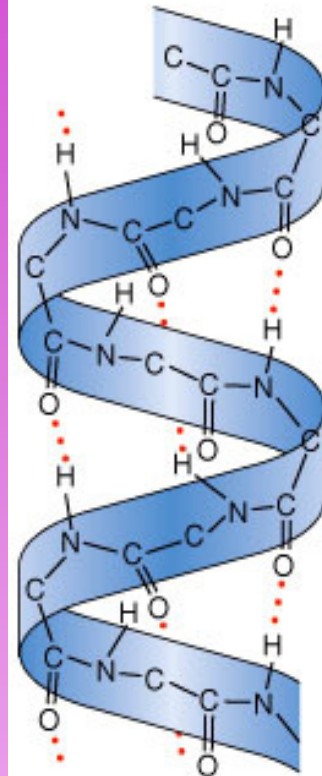
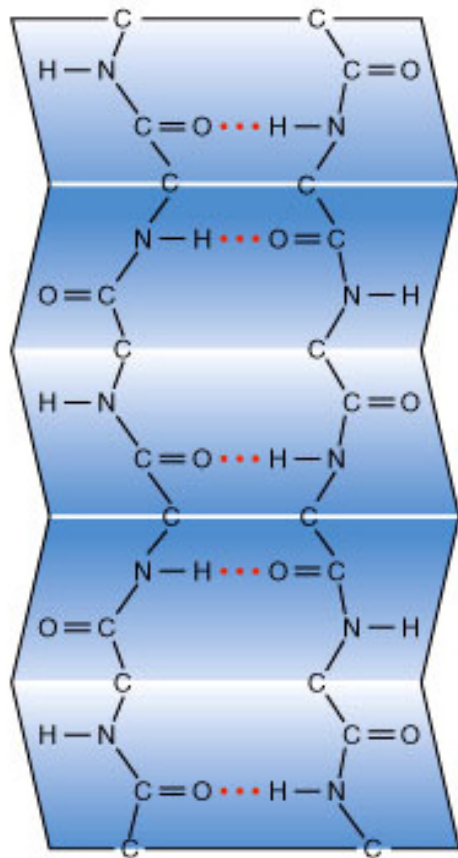


Graw-Hill Companies, Inc. Permission required for reproduction or display.

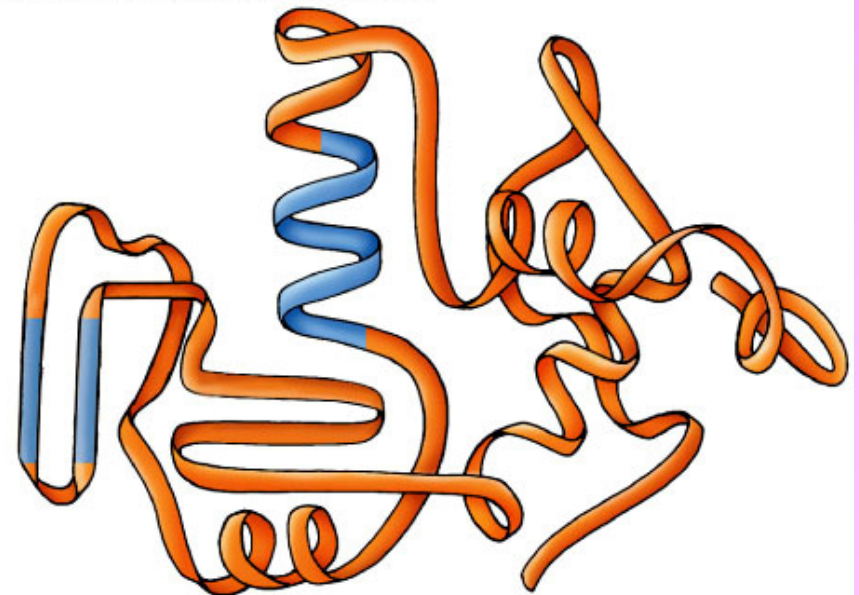


- Fold or coil to form 3-D shapes which is important in performing their functions
- **Denaturation** =
 - The change in the shape of a protein caused by breaking hydrogen bonds
 - Caused by heat or pH change
 - Makes proteins nonfunctional

es, Inc. Permission required for reproduction or display.



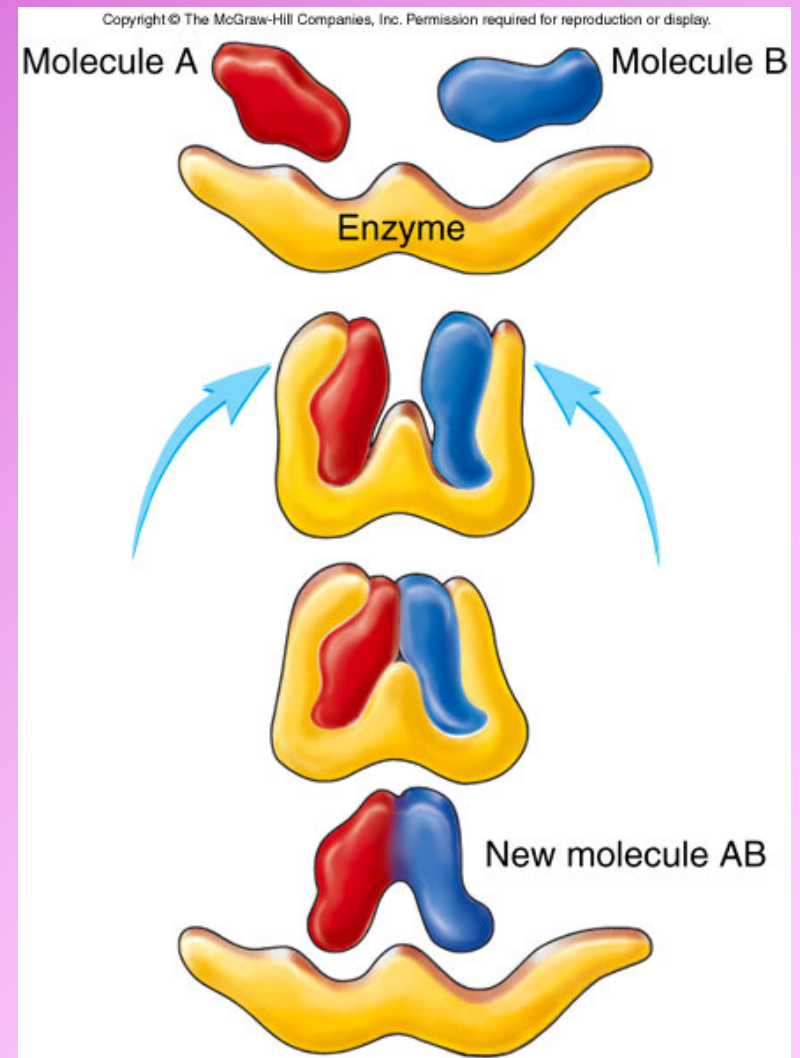
Companies, Inc. Permission required for reproduction or display.



- **Enzyme** =

- Protein catalyst that increase the rate at which a chemical reaction proceeds without the enzyme being permanently changed
- Lower the **activation energy** =
 - Energy necessary to start a chemical reaction

- “Lock and Key” Model =
 - Shape of an enzyme and of the reactants allow the enzyme to bind easily to the reactants
 - Thus enzymes are very specific for the reactions they control



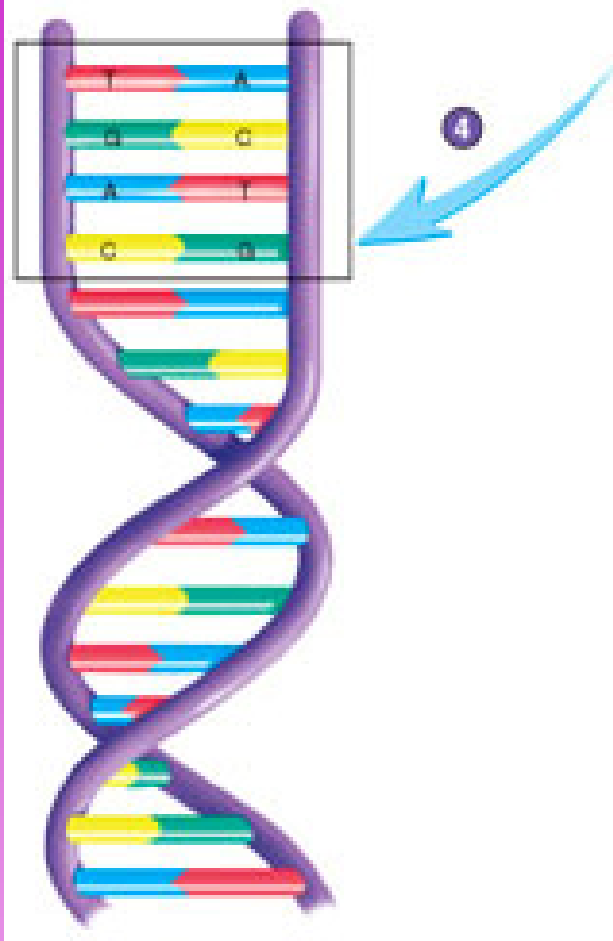


Nucleic Acids: DNA and RNA

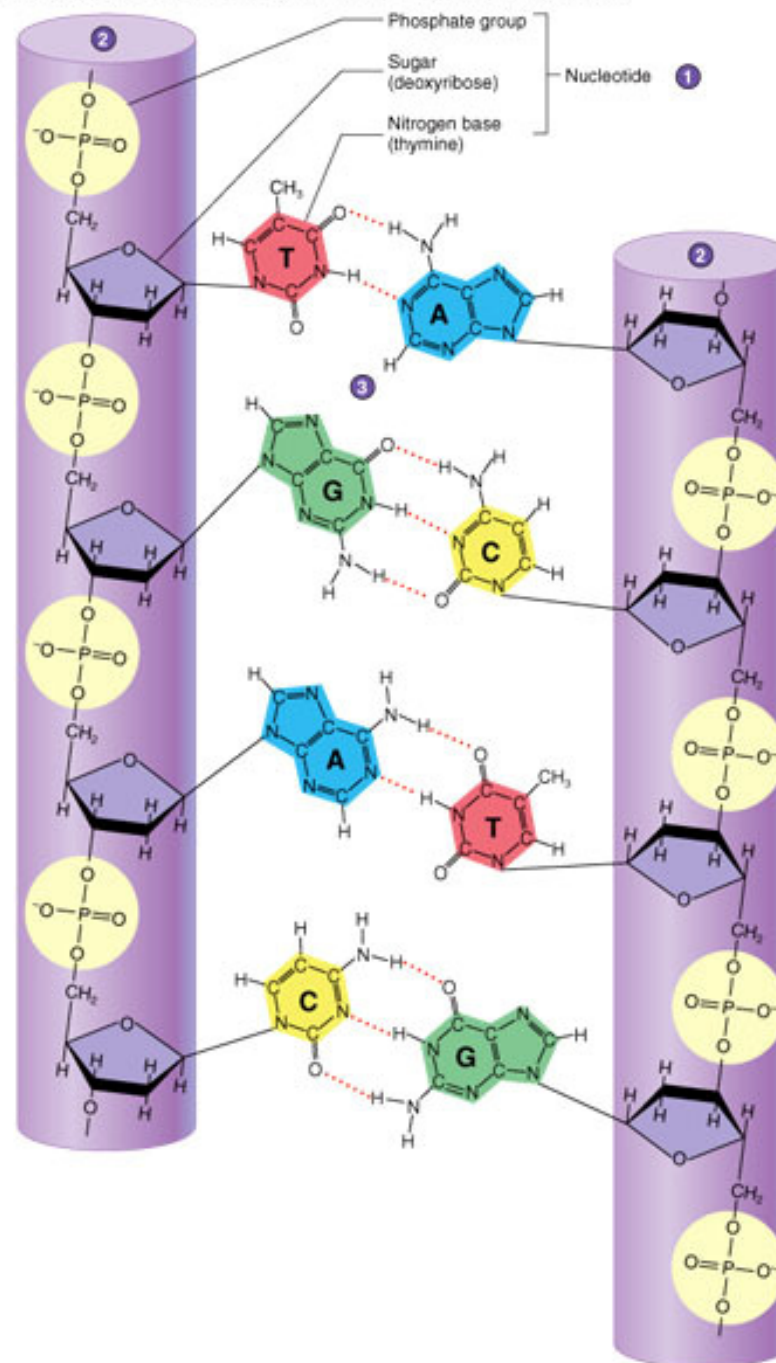
- Information carrying molecules
- 2 types
 - **Deoxyribonucleic Acid (DNA)=**
 - Genetic material of cells
 - **Ribonucleic Acid (RNA)=**
 - Important in protein synthesis

- **Nucleotides** =
 - Basic building blocks of nucleic acids
 - Consist of
 - A sugar molecule
 - A phosphate group
 - Nitrogenous bases

Cytosine (C) Guanine (G)
Thymine (T) Adenine (A)



raw-Hill Companies, Inc. Permission required for reproduction or display.



DNA

- Sugar
 - Deoxyribose
- Nitrogenous bases
 - Adenine
 - Guanine
 - Cytosine
 - Thymine
- Double Strand

RNA

- Sugar
 - Ribose
- Nitrogenous bases
 - Adenine
 - Guanine
 - Cytosine
 - Uracil
- Single Strand
- 3 types
 - Messenger RNA (mRNA)
 - Transfer RNA (tRNA)
 - Ribosomal RNA (rRNA)

Adenosine Triphosphate (ATP)

- **Stores and provides energy**
- Consists of
 - Adenosine
 - Ribose and Adenine
 - 3 phosphate groups
 - Energy is stored in bonds between phosphate groups
 - Energy is released when that bond is broken

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

